

Exercises Week 4 Some preliminary code:

```
module LabExerc4 where

import List
import LAI9
import LAI10
import LAI11
import LAI12
import LAI13
import LAI14
```

1. The complement of a binary relation R on a set A is the set of all pairs that are members of A^2 but not members of R . Implement this as a function

```
complement :: Eq a => [a] -> Rel a -> Rel a
```

2. Muddy children once more. We are going to implement what we found out in the pencil and paper exercises of this week.

Three children are standing in a circle. Each child is facing the others, but the children have their eyes closed. It is common knowledge that they all have their eyes closed. In fact, a and b are muddy, c is not.

An implementation for the model of this situation is:

```
initMuddy :: EpistM State
initMuddy =
  Mo
  [0..7]
  [a,b,c]
  (zip [0..7] (powerList [P 1, P 2, P 3]))
  [(ag, x, y) | ag <- [a,b,c], x <- [0..7], y <- [0..7]]
  [6]
```

The model looks like this:

```
LabExerc4> displayS5 initMuddy
[0,1,2,3,4,5,6,7]
[(0, []), (1, [p3]), (2, [p2]), (3, [p2,p3]), (4, [p1]),
```

```

(5, [p1,p3]), (6, [p1,p2]), (7, [p1,p2,p3]))
(a, [[0,1,2,3,4,5,6,7]])
(b, [[0,1,2,3,4,5,6,7]])
(c, [[0,1,2,3,4,5,6,7]])
[6]

```

The children open their eyes. Two of them see mud on the forehead of one of the others. The third one (*c*) sees two muddy faces. Implement an appropriate action model `openEyes` to capture what goes on in the action of the children opening their eyes.

Hint: you will need the following preconditions:

```

case1 = Conj [p1,p2,p3]
case2 = Conj [Neg p1,p2,p3]
case3 = Conj [p1,Neg p2,p3]
case4 = Conj [Neg p1,Neg p2,p3]
case5 = Conj [p1,p2,Neg p3]
case6 = Conj [Neg p1,p2,Neg p3]
case7 = Conj [p1,Neg p2,Neg p3]
case8 = Conj [Neg p1,Neg p2,Neg p3]

```

3. Give a Haskell definition of the epistemic model that results from updating the epistemic model `initMuddy` with the action model `openEyes`. Call this model `muddy2`. Check the outcome.
4. Father says: “*At least one of you is muddy*”. Implement the corresponding action model as `atLeastOneMuddy`.
5. Implement the epistemic model that results from updating the model from Exercise 3 with the action model from Exercise 4 as `muddy3`. Check the outcome.
6. Children *a*, *b* and *c* make public announcements to the effect that they do not know whether they are muddy or not. Implement an action model to capture this as `abcKnowNot`.
7. Implement the epistemic model that results from updating the epistemic model from Exercise 5 with the action model from Exercise 6 as `muddy4`. Check the outcome.
8. Now children *a* and *b* publicly announce that they know whether they are muddy or not. Implement an appropriate action model for this as `abKnow`.

9. Implement the epistemic model that results from updating the epistemic model from Exercise 7 with the action model from Exercise 8, as `muddy5`. Check the outcome.

HOMEWORK: Exercises 2 through 9.